Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] A method for manufacturing methanol and acetic acid, characterized by the integrated steps of:

autothermally reforming a hydrocarbon stream with oxygen, steam and carbon dioxide to produce a syngas stream;

separating a portion of the syngas stream into a carbon dioxide-rich stream, a hydrogen-rich stream, and a carbon monoxide-rich stream;

recycling the carbon dioxide-rich stream to the autothermal reforming step;

compressing a remaining portion of the syngas stream, with at least a portion of the hydrogen-rich stream to supply a makeup stream having a SN between 2.0 and 2.1 to a methanol synthesis loop to obtain a methanol product;

synthesizing acetic acid from at least a portion of the methanol product and the carbon monoxide-rich stream.

[c2] The method of claim 1, further comprising:

combining a hydrogen-containing stream with a natural gas feed containing higher hydrocarbons to form

a hydrogen containing feed stream; and
contacting said feed stream with a hydrogenation catalyst at hydrogenation temperatures to produce a pretreated stream lean in higher hydrocarbons.

[c3] The method of claim 1, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 5 to 50 percent of the syngas stream, and the remaining portion comprises from 50 to 95 percent of the syngas stream.

[c4] The method of claim 1, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 5 to 40 percent of the syngas stream, and the remaining portion comprises from 60 to 95 percent of the syngas stream.

[c5] The method of claim 1, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 10 to 30 percent of the syngas stream, and the remaining portion comprises from 70 to 90 percent of the syngas stream.

[c6] The method of claim 1, wherein the portion of the syn-

gas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 15 to 25 percent of the syngas stream, and the remaining portion comprises from 75 to 85 percent of the syngas stream.

[c7] The method of claim 1 wherein the SN is between 2.04 and 2.06.

[c8] The method of claim 1, further comprising supplying a purge gas stream from the methanol synthesis loop to fuel, the separation step, the prereforming step, or a combination thereof.

[c9] The method of claim 1, further comprising supplying the portion of the hydrogen-rich stream from the separating step to the prereformer.

[c10] The method of claim 1, wherein the purge gas stream from the methanol synthesis is purified in a PSA unit to produced a purified hydrogen stream.

[c11] The method of claim 10, wherein a portion of the purified hydrogen stream is introduced to the methanol synthesis loop to adjust the SN of the feed gas stream.

[c12] The method of claim 1, wherein the methanol produced is between 1,000 and 20,000 metric tons/day.

[c13] The method of claim 1, wherein the acetic acid produced is between 300 and 6,000 metric tons/day.

[c14] The method of claim 1, wherein the reforming step uses a single train autothermal reformer.

[c15] The method of claim 1, further comprising supplying an imported carbon dioxide stream to the methanol synthesis loop.

[c16] The method of claim 15, wherein the imported carbon dioxide stream is supplied from an associated process to the methanol synthesis loop.

[c17] The method of claim 16, wherein the associated process uses the acetic acid as a reactant, uses the methanol product as a reactant, shares oxygen from a common air separation unit, shares common utilities, or a combination thereof.

[c18] The method of claim 17, further comprising:

providing at least a portion of the acetic acid produced to a vinyl acetate monomer (VAM) synthesis loop in the associated process;

combining the portion of the acetic acid with an ethylene source and oxygen to produce vinyl acetate monomer.

[c19] The method of claim 18, wherein a CO2-rich stream is imported to the methanol synthesis loop from the VAM synthesis loop.

[c20] The method of claim 1, wherein the separating step produces a tail gas stream rich in inerts.

[c21] A method for manufacturing methanol and acetic acid, characterized by the integrated steps of:

combining a hydrogen-containing stream with a natural gas feed containing higher hydrocarbons to form a hydrogen containing feed steam;

contacting the hydrogen-containing feed stream with a hydrogenation catalyst at hydrogenation temperatures to produce a pretreated stream lean in higher hydrocarbons;

autothermally reforming the pretreated stream with oxygen, steam, and carbon dioxide to produce a syngas stream;

separating a portion of the syngas stream into a carbon dioxide-rich stream, a hydrogen-rich stream, and a carbon monoxide-rich stream;

recycling the carbon dioxide-rich stream to the autothermal reforming step;

compressing a remaining portion of the syngas stream, with at least a portion of the hydrogen-rich

stream to supply a makeup stream having a SN between 2.0 and 2.1 to a methanol synthesis loop to obtain a methanol product;

recovering a purge gas stream from the methanol synthesis loop;

synthesizing acetic acid from at least a portion of the methanol product and the carbon monoxide-rich stream.

[c22] The method of claim 21, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 5 to 50 percent of the syngas stream, and the remaining portion comprises from 50 to 95 percent of the syngas stream.

[c23] The method of claim 21, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 5 to 40 percent of the syngas stream, and the remaining portion comprises from 60 to 95 percent of the syngas stream.

[c24] The method of claim 21, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 10 to 30 percent of the syngas stream, and

the remaining portion comprises from 70 to 90 percent of the syngas stream.

[c25] The method of claim 21, wherein the portion of the syngas stream separated into the carbon dioxide-rich, the hydrogen-rich and carbon monoxide-rich streams comprises from 15 to 25 percent of the syngas stream, and the remaining portion comprises from 75 to 15 percent of the syngas stream.

[c26] The method of claim 21, further comprising supplying the purge gas stream from the methanol synthesis loop to fuel, the separation step, the prereforming step, or a combination thereof.

[c27] The method of claim 21, further comprising supplying a portion of the hydrogen-rich stream from the separating step to the prereforming step.

[c28] The method of claim 21, wherein the purge gas stream from the methanol synthesis is purified in a PSA unit to produce a purified hydrogen stream.

[c29] The method of claim 28, wherein a portion of the purified hydrogen stream is introduced to the methanol synthesis loop to adjust the SN of the feed gas stream.

[c30] The method of claim 21, wherein the SN is between 2.04

and 2.06.

[c31] The method of claim 21, wherein the methanol produced is between 1,000 and 20,000 metric tons/day.

[c32] The method of claim 21, wherein the acetic acid produced is between 300 and 6,000 metric tons/day.

[c33] The method of claim 21, wherein the reforming step uses a single train autothermal reformer.

[c34] The method of claim 21, further comprising:

providing at least a portion of the acetic acid produced to a vinyl acetate monomer (VAM) synthesis loop in an associated process;

combining the portion of the acetic acid with an ethylene source and oxygen to produce vinyl acetate monomer.

[c35] The method of claim 34, wherein the associated process uses the acetic acid as a reactant, uses the methanol product as a reactant, shares oxygen from a common air separation unit, shares common utilities, or a combination thereof.

[c36] The method of claim 34, wherein a CO2-rich stream is imported to the methanol synthesis loop from the VAM synthesis loop.